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RECENT CRITICISMS OF MATHEMATICS TEACHING, AND THEIR RESULTS.*

EASTERN NEW YORK STATE.

By **Arthur M. Curtis,**

State Normal School, Oneonta, N. Y.

The following questionnaire was sent to about twenty representative school and college men: city superintendents, college professors, normal and high-school instructors.

I. Who are the leading critics of mathematics teaching?

II. What are their viewpoints?

III. What changes have you noted in the time allotted to mathematics in high-school courses and in college courses?

IV. Have there been appreciable changes in the arrangement of the courses?

V. What changes in length of courses do you suggest?

VI. Is the preparation of your entering classes (in high school or college) improving or declining?

VII. To what do you ascribe this change (in No. VI.)?

N. B. The questions refer to a period of time not more than five to ten years back from the present.

Their answers were as follows:

I. (*a*) The teachers of mathematics themselves.
   (*b*) Teachers of other subjects in the curriculum.
   (*c*) Many individuals mentioned, authors, etc.
   (*d*) "Half-baked" psychologists.
   (*e*) Vocationists.
   (*f*) The public—utilitarian public.
II. (*a*) Dissatisfaction with their own results.
   (*b*) Jealousy of time demanded by mathematics in lesson preparation.

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* Reports from different parts of the Middle States and Maryland given at the spring meeting. On account of their similarity it has seemed best to condense them into one article.

(*c*) All forms of "isms" from the Snedden viewpoint to the extreme classicist—the *old* school.
(*d*) The denial of transference, etc.
(*e*) Everything must be immediately useful and have an *earning* value.
(*f*) Quite like (*e*).

III. (*a*) None noteworthy.
(*b*) More time (one and one half years in many schools) for elementary algebra.
(*c*) Making algebra elective (in prospect, not as yet accomplished).
(*d*) More time for analytics.

IV. (*a*) Elementary algebra to be followed immediately by intermediate algebra, rather than separated by two years.
(*b*) Analytical geometry and calculus in one course.

V. (*a*) Same as III. (*d*).
(*b*) Geometry in first-year high school.
(*c*) Shorten elementary algebra to the study of the equation.
(*d*) Place arithmetic in high school course.
(*e*) "Don't take the 'pep' out of the subject."
(*f*) Emphasize principles in the courses and rapidity in process.

VI. Eight answered "Declining,"
Four answered "The same,"
Three answered "Better,"
and a few gave no opinion.
One—"Some send good always and others send poor always."

VII. (*a*) Too little of the joy of achievement.
(*b*) Effect (for "Better") of scholarships now given by the state.
(*c*) Poor ineffective teaching in first-year algebra inducing a dislike for the subject.
(*d*) The looseness in thought expression in other lines contributes to inaccuracy, and is most apparent in arithmetic.
(*e*) Too many subjects and not enough concentration of effort.

(*f*) Outside interests too numerous.
(*g*) Lack of "background."
(*h*) Emphasis on memorizing instead of thinking.
(*i*) I see the facts (of decline), but do not know to what to ascribe them.

New York City.

By Forrest A. De Graff,
Stuyvesant High School.

To secure the information asked for in questions (*b*) and (*c*) of today's program, a questionnaire embodying them was addressed to fifteen high schools and five colleges in New York City, as well as to several representative institutions in nearby municipalities whose industrial problem seemed to invite adjustments of mathematical courses. Although several replies are lacking, an effort has been made through personal conferences and perusal of catalogs to supply the missing information.

From some quarters there are evidences of serious disturbances, while in others we find quite well developed plans for industrialized and commercialized mathematics designed to still public clamors, and at the same time soothe the well-grounded fears of that other group who are content with the traditional.

That the *teaching* of mathematics should show a rational motivation, that the subject should be shown to have a broader adaptation to the affairs of daily life, and that there should be given a greater measure of liberty to the more mature pupil in the matter of choosing certain mathematical subjects for study —these three considerations appear to be quite generally accepted as sound and proper lines, along which reforms of courses may be safely pursued; but hysterical demands for a thorough housecleaning (prefacing, I suppose, a general removal) have met with comparatively little sympathy in this vicinity, and the present prospect fails to show any general trend toward such a realization of the hopes of certain enthusiasts.

The influence of the utilitarians is everywhere observable, but the concept of utility has been dignified, has lost much of its cheapness, and in some of our schools, it has become the central idea around which strong, well-balanced courses of real mathematics are being constructed. There is also abundant evidence that another well-known exhortation, "Every subject of study should be made to function in the life of the child," is being carried out without sacrificing what the *adult* may require, thereby transferring the emphasis from the *child* to *life*, and that in its broadest sense.

The transferring of several topics of elementary algebra to intermediate by the regents seems to have met with general approval, chiefly because time is thus released for some other required subject or an opportunity is thus given for supervised study and drill. The omission of certain propositions from geometry, determinants from advanced algebra, and the permission to use the text of plane trigonometry during examination have all been accepted more or less gracefully for similar reasons.

In the technical high schools such as Stuyvesant we have shop mathematics as a doorway to algebra largely through the medium of the formula, also the courses in applied mathematics for co-operative students who alternate school and shop, and whose mathematical needs require the study of the whole range of elementary subjects from the practical viewpoint. The commercial high schools are meeting the demand for the utilizing of mathematics by working out courses in commercial algebra, and in making all mathematics more vocational.

In one commercial high school, however, all mathematics, except commercial arithmetic, is made elective, with results that, needless to say, are very unsatisfactory to the mathematics department. The statement is made that the course is not comparable to any other in the city high schools, and the hope is expressed that before long a more extensive one will take its place. Changes of like nature are being discussed at a very large girls' industrial high school. In these two schools only does the course of real mathematics seem to be languishing for the want of stronger administrative support.

Only one out of twenty high schools reporting indicated a change in the amount of time allotted, and in this case there is a slight reduction. The same school, together with another of the same type (commercial), shows a decrease in the number of students electing mathematics.

In Columbia, New York University, Fordham, Adelphi and Barnard we find no change in the allotment of time given to mathematics; and there is an appreciable increase in the relative number of students in Columbia, Barnard, and Fordham. Adelphi remains unchanged in this respect, while New York University shows a slight relative decrease. Adelphi will give less solid geometry and more trigonometry, also less theory of numbers; mathematics has been optional, however, since the beginning of the college. No change in the arrangement of courses and no reconstruction are reported in Columbia, Barnard, and New York University.

MIDDLE AND WESTERN NEW YORK STATE.

By Floyd F. Decker,

Syracuse University.

Through this district there is little criticism of mathematics teaching. The requirements in school and college have not been changed to any appreciable extent. The question as to the relative number of pupils taking high-school mathematics seemed hard to answer definitely. The following table, however, gives the number of pupils per thousand of enrollment who presented answer papers to the regents in the years shown.

	1904-6.	1905-7.	1906-8.	1907-9.	1908-10.	1909-12.	1910-13.	1912-13.
All mathematics	328	380	439	494	510	513	518	528
First algebra	178	199	224	246	250	250	254	265
Plane geometry	112	128	142	157	159	162	166	168
Second algebra	10.5	20.2	33.6	48.8	56.2	58.5	58.9	58.4
Third algebra			8.5	9.0	12.5	9.3	9.0	9.1
Solid geometry	19.1	19.9	21.4	22.2	22.3	21.6	20.7	20.6
Average of plane and spherical trigonometry	6.5	7.8	9.2	9.8	11.1	9.9	9.3	6.9

In the college course there is a tendency to combine analytic geometry and calculus, and courses giving a general view of mathematics are being added.

WESTERN NEW YORK.

BY WILFRED H. SHERK,

Lafayette High School, Buffalo.

In gathering the material for this report of the results of the recent criticisms of mathematics teaching in western New York, a questionnaire was sent to one hundred and twenty high schools and to ten colleges. Three of the colleges were not in the section covered by the report. The statistics compiled from the replies do not necessarily indicate the *trend* of mathematics teaching in this section, for the statistical method gives just as much weight to the opinion of the least progressive and the least competent teacher as to that of the most progressive and the most competent. However, these statistics do furnish a general notion of the teaching in this territory as it actually is, and this, I understand, is the object of the survey.

Vitalizing Mathematics.

In the first place all of the high schools from which replies were received are trying in one way or another to vitalize mathematics. They are trying to discover and to use natural points of contact of mathematics with the other interests of the pupils. It does not appear that teachers are consciously emphasizing the applications of mathematics, as opposed to its intrinsic value or its potential utility. They have simply found as a matter of experience that applications which are real and which connect mathematics with the rest of the pupil's life are interesting and furnish an excellent motive for studying the subject.

Laboratory Method.

With reference to the laboratory method it may be said that in arithmetic many of our grammar schools are using it with success. Children weigh, measure, buy and sell, make change, write checks, make out bills and payrolls, and so forth. If under the caption "laboratory method" we include study under supervision, special work undertaken to assist backward or brilliant pupils, and all that work on the part of the pupil which is done under the immediate direction of the teacher, then the laboratory method is used very extensively in western New York. The number of schools that are encouraging study under supervision is noteworthy.

Parallel Courses; Correlation; Fusion or General Mathematics.

Most of the schools in this section still teach arithmetic, algebra, geometry and trigonometry in the traditional sequence. Correlation of the mathematical subjects among themselves is on the increase, but no school reported that it was attempting to correlate mathematics with any other subject except, possibly, drawing. This tendency toward correlation was especially noticeable in the larger schools. Algebra is correlated with arithmetic by introducing the algebraic formula and the linear equation; geometry with arithmetic through mensuration; geometry with algebra by the introduction of simple geometric problems capable of algebraic solution; trigonometry with geometry by the introduction of trigonometric ratios in connection with similar triangles; surveying with trigonometry through the solution of triangles.

Rochester in its junior high school and Buffalo in the Hutchinson high school are running algebra and geometry in parallel courses with much correlation between the two. There is no secondary school in western New York that I know of in which fusion or general mathematics is being taught. It is worth noting, however, that parallel courses between which there is a great deal of correlation may easily become fused.

The question of the wisdom of requiring algebra and geometry of all high-school pupils has not been raised in western New York, and the number of pupils electing mathematics is on the whole increasing.

In the colleges Dr. Gale, of the University of Rochester, is trying to unify the work of the freshman year around the function idea. Other college men in this section, while not actively participating in the experiment, believe that it is being conducted along right lines, and are awaiting the results with a great deal of interest.

MARYLAND.

By EUGENE RANDOLPH SMITH,

The Park School, Baltimore.

There has been little change in either school or college mathematics in Maryland. Some unimportant criticisms of the subject have been made and answered, but without effect on the general procedure. Individual schools are using the more modern methods in arithmetic and are doing progressive work in the high-school subjects, but the state as a whole has not been greatly influenced by recent developments.

The Johns Hopkins University still requires plane trigonometry in addition to the usual subjects for entrance to the academic course, and requires all freshmen to take two of the three subjects, analytics, physics and Latin. The fusion of subjects in the freshman and sophomore years has been quite thoroughly developed.

Goucher College has just announced that pupils may enter on a comprehensive examination plan, which makes it possible, but not easy, to enter without mathematics.

NEW JERSEY.

By HARRISON E. WEBB,

Central High School, Newark.

Mr. Webb had not prepared any questionnaire but had made a good many informal inquiries. He felt that the chief critics of mathematics teaching in high school were those teachers or employers to whom students leaving high school were later to be responsible. Many of their criticisms are really directed against conditions which are the result of the present standards of high-school instruction and administration generally, and these criticisms cannot be met primarily by any changes in curriculum or method of mathematics teaching. Others demand our earnest consideration, among them the chief one being that students are unable to apply what mathematics they have either to practical work or to advanced study. The general tendency in New Jersey is to lay greater emphasis upon applications of mathematics, in order to meet this criticism, and also on account of the enormous increase in high-school attendance in the larger cities of New Jersey, most of which will never find its way into college.

This emphasis upon the application of mathematics is shown in three ways:

(*a*) The introduction of arithmetic into the first year of high school. This is based on the idea that there are many important topics in arithmetic which are not suited to the relative immaturity of grammar-school pupils. This work has hitherto been distributed among various other subjects in mathematics or science, but is now often given under its own caption.

(*b*) Applied problems are introduced freely in algebra and geometry.

(*c*) Courses in plane surveying, strength of materials, and business algebra, almost the entire content of which is practical, have been added to the mathematical curriculum.